INCH-POUND
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2 March 2004
SUPERSEDING
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PERFORMANCE SPECIFICATION

CAPACITORS, FIXED, MICA DIELECTRIC, ESTABLISHED RELIABILITY AND NONESTABLISHED RELIABILITY, GENERAL SPECIFICATION FOR

This specification is approved for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers the general requirements for established reliability (ER) and non-established reliability (non-ER), mica dielectric, fixed capacitors (see 6.1). The ER capacitors have a failure rate level (FRL) ranging from 1.0 percent per 1,000 hours to 0.001 percent per 1,000 hours (see 1.2.1.7). The FRL is established at a 90 percent confidence level. The FRL, identified by the applicable symbol specified in table V is referred to operational life at full rated voltage (see 1.2.1.6) at 125°C or 150°C, as applicable. An acceleration factor of 25:1 has been used to relate the life test at 150 percent of rated voltage at rated temperature to rated voltage at rated temperature."

1.2 Classification.

* 1.2.1 Part or Identifying Number (PIN). The PIN is in the following form and as specified (see 3.1).

CMR04	C	1R0	D	O	D	M
Style (1.2.1.1)	Characteristic (1.2.1.2)	Capacitance (1.2.1.3)	Capacitance tolerance (1.2.1.4)	Operating temperature range (1.2.1.5)	Rated voltage (1.2.1.6)	Product level designator (1.2.1.7)

1.2.1.1 Style. The style is identified by the three-letter symbol "CMR" followed by a two-digit number; the letters identify mica dielectric, fixed capacitors, ER and non-ER, and the number identifies the shape and dimensions of the capacitor.

1.2.1.2 Characteristic. The characteristic is identified by a single letter which indicates the relative stability of the capacitor with temperature change in accordance with table I.

* Comments, suggestions, or questions on this document should be addressed to: US Army Communications-Electronics Command and Fort Monmouth, ATTN: AMSEL-LC-LEO-E-EP, Fort Monmouth, NJ 07703-5023, or e-mailed to jeffrey.carver@mail1.monmouth.army.mil. Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at www.dodssp.daps.mil.

* TABLE I. Characteristic.

Symbol	Temperature coefficient	Capacitance drift
	Parts/million/°C (ppm/°C)	
C	-200 to +200	± (0.5 percent + 0.1 picofarad (pF))
E	-20 to +100	± (0.1 percent + 0.1 pF)
F	-0 to +70	± (0.05 percent + 0.1 pF)

* 1.2.1.3 Capacitance. The nominal capacitance value expressed in pF is identified by a three-digit number; the first two digits represent significant figures and the last digit specifies the number of zeros to follow. When the nominal value is less than 10 pF, the letter R is used to indicate the decimal point and the succeeding digit(s) of the group represent significant figure(s). For example 1R0 indicates 1.0 pF; R75 indicates 0.75 pF; and 0R5 indicates 0.5 pF.

1.2.1.4 Capacitance tolerance. The capacitance tolerance in percent or pF, as applicable, is identified by a single letter in accordance with table II.

TABLE II. Capacitance tolerance.

Symbol	Capacitance tolerance
D	±0.5 pF
F	±1 percent
G	±2 percent
J	±5 percent

1.2.1.5 Operating temperature range. The operating temperature range is identified by a single letter in accordance with table III.

TABLE III. Operating temperature range.

Symbol	Operating temperature range, °C
O	-55 to +125
P	-55 to +150

1.2.1.6 Rated voltage. The rated voltage is identified by a single letter in accordance with table IV.

TABLE IV. Rated voltage.

Symbol	DC rated voltage, volts
A	100
C	300
D	500
Y	50

1.2.1.7 Product level designator. The FRL in percent per 1,000 hours is identified by a single letter in accordance with table V and is based on rated voltage at 125°C or 150°C, as applicable.

TABLE V. Product level designator.

Symbol	Product level designator
C	----
M	1.0 percent per 1,000 hours
P	0.1 percent per 1,000 hours
R	0.01 percent per 1,000 hours
S	0.001 percent per 1,000 hours

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3 and 4 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements documents cited in sections 3 and 4 of this specification, whether or not they are listed.

2.2 Government documents.

* 2.2.1 Specifications. standards. and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract (see 6.2).

DEPARTMENT OF DEFENSE SPECIFICATIONS

MIL-C-5	-	Capacitors, Fixed, Mica Dielectric, General Specification For.
MIL-PRF-39001/5	-	Capacitors, Fixed, Mica Dielectric, Established Reliability, Styles CMR03, CMR04, CMR05, CMR06, CMR07, and CMR08.

DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-202	-	Electronic and Electrical Components Parts.
MIL-STD-690	-	Failure Rate Sampling Plans and Procedures.
MIL-STD-790	-	Established Reliability and High Reliability Qualified Products List (QPL) Systems for Electrical, Electronic, and Fiber Optic Parts Specifications.
MIL-STD-810	-	Environmental Engineering Considerations and Laboratory Tests.
MIL-STD-1276	-	Leads for Electronic Component Parts.
MIL-STD-1285	-	Marking of Electrical and Electronic Parts.

* (Copies of these documents are available online at http://assist.daps.dla.mil/quicksearch/ or www.dodssp.daps.mil or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

* 2.3 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

ELECTRONIC INDUSTRIES ALLIANCE (EIA)

EIA-554-1		Assessment of Outgoing Nonconforming Levels in Parts Per Million (PPM).
EIA-557	-	Statistical Process Control Systems. (DoD adopted)

* (Copies of these documents are available from http://global.ihs.com or Global Engineering Documents, Attn: Customer Service Department, 15 Inverness Way East, Englewood CO 80112-5776.)

2.4 Order of precedence. In the event of a conflict between the text of this document and the references cited herein (except for related specification sheets), the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Specification sheet. The individual item requirements shall be as specified herein and in accordance with the applicable specification sheet. In the event of any conflict between the requirements of this specification and the specification sheet, the later shall govern (see 6.2).

3.2 Qualification. Capacitors furnished under this specification shall be products that are authorized by the qualifying activity for listing on the applicable Qualified Products List (QPL) before contract award (see 4.4 and 6.4). Authorized distributors which are approved to MIL-STD-790 distributor requirements by the QPL manufacturers are listed in the QPL.

3.3 QPL system. The manufacturer shall establish and maintain a QPL system for parts covered by this specification. Requirements for this system are specified in MIL-STD-790 and MIL-STD-690. In addition, the manufacturer shall also establish a Statistical Process Control (SPC) and Part Per Million (ppm) system that meets the requirements as detailed in 3.3.1 and 3.3.2 respectively.

3.3.1 SPC system. As part of the overall MIL-STD-790 QPL system the manufacturer shall establish a SPC system that meets the requirements of EIA-557.

3.3.2 PPM. As part of the overall MIL-STD-790 QPL system, the manufacturer shall establish a ppm system of assessing the average outgoing quality of lots in accordance with EIA-554-1. Data exclusion, in accordance with EIA-554-1, may be used with approval of the qualifying activity. The ppm system shall identify the ppm rate at the end of each month and shall be based on a 6-month moving average. Style reporting may include both ER and non-ER style combinations.

3.4 Material. The material shall be as specified herein. However, when a definite material is not specified, a material shall be used which will enable the capacitors to meet the performance requirements of this specification. Acceptance or approval of any constituent material shall not be construed as a guaranty of the acceptance of the finished product.

3.4.1 Terminal leads. Leads shall be solderable and meet the solderability requirements of 3.12.

3.4.2.1 Solder dip (retinning) leads. Only the manufacturer (or his authorized category B or category C distributor) may solder dip/retin the leads of products supplied to this specification provided the solder dip process has been approved by the qualifying activity (see 3.4.2.3).

3.4.2.2 Qualifying activity approval. Approval of the solder dip process shall be based on one of the following options:

a. When the original lead finish qualified was hot solder dip lead finish 52 of MIL-STD-1276, the manufacturer shall use the same solder dip process for retinning as is used in the original manufacture of the product. (NOTE: The 200 microinch maximum thickness is not applicable.)

b. When the lead originally qualified was not hot solder dip lead finish 52 of MIL-STD-1276 as prescribed in 3.4.2.2a., approval for the process to be used for solder dip shall be based on the following test procedure:

(1) Thirty samples of any capacitance value for each style and lead finish are subjected to the manufacturer's solder dip process. Following the solder dip process, the capacitors are subject to the high voltage stabilization, dielectric withstanding voltage (DWV), insulation resistance (IR), capacitance, and dissipation factor (DF) measurements. No defects are allowed.

(2) Ten of the 30 samples are then subjected to the solderability test. No defects are allowed.

(3) The remaining 20 samples are subject to the resistance to solder heat test. No defects are allowed. (NOTE: Solder dip of gold plated leads is not allowed.)

3.4.2.3 Solder dip/retinning options. The manufacturer (or authorized category B or category C distributor) may solder dip/retin as follows (see 3.4.2.1):

a. As a corrective action if the lot fails the group A solderability test.

b. After the group A inspection has been completed, following the solder dip/retinning process, the high voltage stabilization, DWV, IR, capacitance, and DF measurements shall be performed on 100 percent of the lot. The percent defective allowable (PDA) for the electrical measurements shall be as for the subgroup 1 tests. Following these tests, the manufacturer shall submit the lot to the group A solderability test as specified in 4.7.8.

3.5 Interface and physical dimensions. Capacitors shall meet the interface and physical dimensions specified (see 3.1).

3.5.1 Tin plated finishes. Tin plating is prohibited as a final finish or as an undercoat. Tin-lead (Sn-Pb) finishes are acceptable provided that the minimum lead content is three percent (see 6.9).

3.6 DWV. Capacitors shall withstand the direct-current (dc) potential specified in 4.7.2 without damage, arcing, or breakdown.

3.7 High voltage stabilization. When capacitors are tested as specified in 4.7.3, there shall be no evidence of damage, arcing, or breakdown; and the IR shall be not less than the applicable value specified on figure 1 or in table VI.

3.8 Barometric pressure (for qualification only). Capacitors shall withstand the dc potential specified in 4.7.4 without damage, arcing, or breakdown.

3.9 IR (see 4.7.5).

3.9.1 At room ambient temperature. When measured as specified in 4.7.5.1, the IR shall be not less than the applicable value specified on figure 1 or in table VI.

3.9.2 At high ambient temperature. When measured as specified in 4.7.5.2, the IR shall be not less than the applicable value specified on figure 1 or in table VI.

TABLE VI. IR.

Capacitance rating	Minimum IR
At 25°C	
0 pF to 10,000 pF	100,000 megohms
10,000 pF and greater	1,000 megohms-microfarads 1/
At 125°C	
0 pF to 3,300 pF	10,000 megohms
3,300 pF and greater	33 megohm-microfarads
At 150°C	
0 pF to 1,500 pF	5,000 megohms
1,500 pF and greater	7.5 megohm-microfarads

1/ Product obtained by multiplying the capacitance in microfarads by the IR in megohms.

3.10 Capacitance. When measured as specified in 4.7.6, the capacitor shall be within the tolerance shown in the type designation (see 3.1).

3.11 DF. When measured as specified in 4.7.7, the DF shall not exceed the applicable value shown on figure 2.

3.12 Solderability. When capacitors are tested as specified in 4.7.8, the dipped surface of the lead shall be at least 95 percent covered with continuous new solder coating. The remaining 5 percent of the lead surface shall show only pinholes or voids. These shall not be concentrated in one area. No individual view of the dipped surface shall show less than 95 percent coverage. Bare base metal and areas where the solder dip failed to cover the original coating are indications of poor solderability and shall be cause for failure. In case of dispute, the percent of coverage with pinholes or voids shall be determined by actual measurement of these areas, as compared to the total area.

3.13 Vibration. When capacitors are tested as specified in 4.7.9, there shall be no intermittent contacts of 0.5 milliseconds (ms) or greater duration, or momentary arcing, or other indication of breakdown, nor shall there be any open-circuiting or short-circuiting or evidence of mechanical damage.

3.14 Temperature coefficient and capacitance drift. When measured as specified in 4.7.10, the temperature coefficient and capacitance drift shall be within the limits specified in table I for the characteristic listed (see 3.1).

3.15 Thermal shock and immersion. When tested as specified in 4.7.11, capacitors shall meet the following requirements:

a. DWV: As specified in 3.6.

b. IR: Shall be not less than 30 percent of initial requirement (see 3.9).

c. Capacitance: The capacitance change shall not exceed 1 percent or 1 pF, whichever is greater, from the reference measurement (see 4.3.2.1).

d. DF: Shall not exceed 150 percent of the initial requirement specified in 3.11.

e. Visual examination: No visible evidence of deterioration, permanent damage to leads or case, or corrosion on leads.

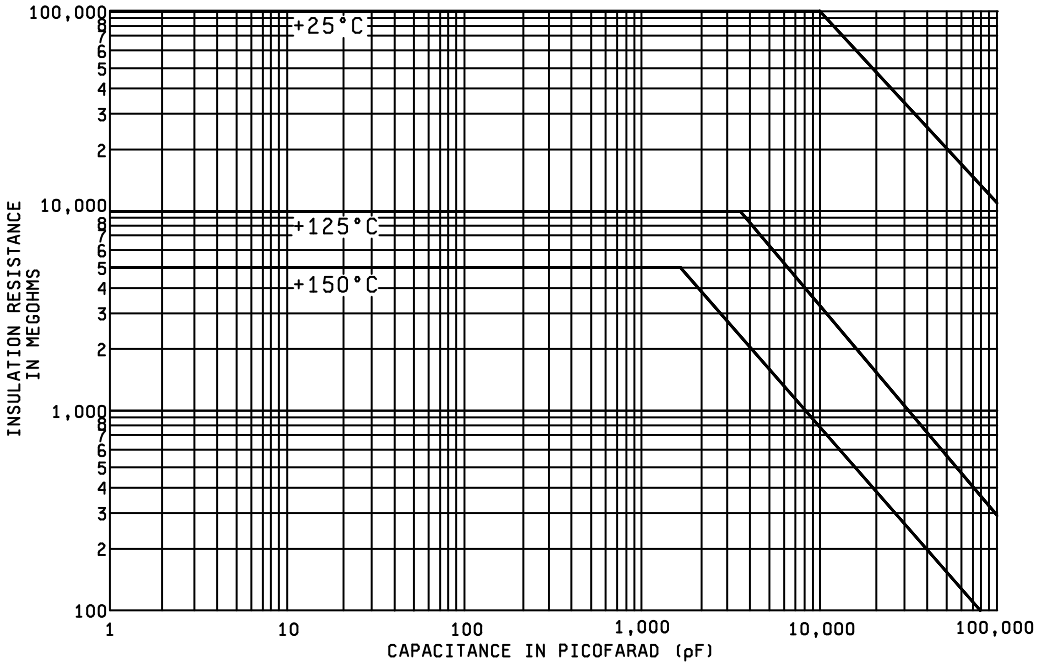

FIGURE 1. IR versus capacitance at test temperature.

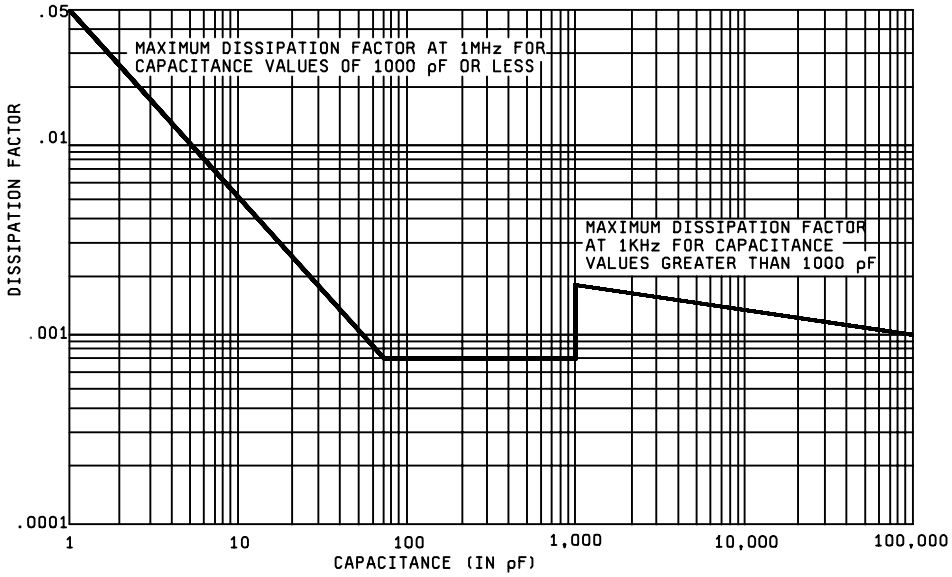

FIGURE 2. Capacitance value versus DF.

3.16 Shock, specified pulse. When capacitors are tested as specified in 4.7.12, there shall be no intermittent contacts of 0.5 ms or greater duration, or momentary arcing, or other indication of breakdown, nor shall there be any open-circuiting or short-circuiting or evidence of mechanical damage.

3.17 Terminal strength. When capacitors are tested as specified in 4.7.13, the terminals shall not loosen or rupture and no other damage shall result. Chipping of the resinous coating on the leads, in the "R" dimension area only (see 3.1), shall not be considered a failure.

3.18 Resistance to soldering heat. When tested as specified in 4.7.14, capacitors shall meet the following requirements:

a. IR: Shall not be less than the initial requirement (see 3.9).

b. Cap: The capacitance change shall not exceed ±5 percent or ±5 pF, whichever is greater, from the initial measurement.

c. DF: Shall not exceed initial requirement.

3.19 Moisture resistance. When tested as specified in 4.7.15, capacitors shall meet the following requirements:

a. DWV: As specified in 3.6.

b. IR: Shall be not less than 25 percent of the initial requirement (see 3.9).

c. Cap: The capacitance change shall not exceed 1 percent or 1 pF, whichever is greater, from the reference measurement (see 4.3.2.1).

d. DF: Shall not exceed 150 percent of the initial requirement specified in 3.11.

e. Visual examination: No visible evidence of deterioration, permanent damage to the leads or case, nor corrosion on the leads.

3.20 Life. When tested as specified in 4.7.16, capacitors shall meet the following requirements:

a. DWV: As specified in 3.6.

b. IR: Shall not be less than the applicable value specified on figure 1 or in table VI.

c. Cap: The capacitance change shall not exceed ±1 percent or ±1 pF, whichever is greater, of the initial measurement.

d. DF: Shall not be greater than 150 percent of the initial requirement (see 3.11).

e. Visual examination: No visible evidence of deterioration, permanent damage to leads or case, arcing, or breakdown.

3.21 Fungus. The manufacturer shall certify that all external materials are fungus resistant or shall perform the test specified in 4.7.17. When capacitors are tested as specified in 4.7.17, examination shall disclose no evidence of fungus growth on the external surface of the capacitor.

3.22 Resistance to solvents. When capacitors are tested as specified in 4.7.18, marking shall remain legible and shall not smear or rub off. In addition, there shall be no visible indication of damage or deterioration to the capacitor body.

3.23 Marking. Marking of capacitors shall conform to method 1 of MIL-STD-1285, and unless otherwise specified (see 3.1), shall include the type designation, JAN brand, trademark, source code, date code (inspection lot of 4.6.1.1.1), rated voltage, capacitance, capacitance tolerance, and highest rated temperature. Capacitors shall be marked as specified (see 3.1).

3.23.1 "JAN" and "J" marking. The United States Government has adopted, and is exercising legitimate control over the certification marks "JAN" and "J", respectively, to indicate that items so marked or identified are manufactured to, and meet all the requirements of military specifications. Accordingly, items acquired to and meeting all of the criteria specified herein and in applicable specifications shall bear the certification mark "JAN" except that items too small to bear the certification mark "JAN" shall bear the letter "J". The "JAN" or "J" shall be placed immediately before the part number except that if such location would place a hardship on the manufacturer in connection with such marking, the "JAN" or "J" may be located on the first line above or below the part number. Items furnished under contracts or orders which either permit or require deviation from the conditions or requirements specified herein or in applicable specifications shall not bear "JAN" or "J". In the event an item fails to meet the requirements of this specification and the applicable specification sheets or associated specifications, the manufacturer shall remove completely the military part number and the “JAN” or “J” from the sample tested and also from all items represented by the sample. The "JAN" or "J" certification mark shall not be used on products acquired to contractor drawings or specifications. The United States Government has obtained Certificate of Registration Number 504,860 for the certification mark "JAN" and Registration Number 1,586,261 for the certification mark “J”.

3.23.2 MIL-C-5 non-ER marking. An ER part manufactured in accordance with this specification may be marked and furnished as a non-ER part from MIL-C-5 if produced on the same assembly line, and provided it is subjected to and meets all the inspection requirements of the ER part.

3.23.3 Substitutability of FRL and product levels. A manufacturer may supply to all higher FRLs than to which he is qualified, see table VII. Parts qualified and marked to lower FRLs, with acquiring agency approval, are substitutable for higher FRLs, and shall not be remarked unless specified in the contract or acquisition document (see 6.2).

TABLE VII. FRL and product level substitutability.

Parts qualified to FRL	Are substitutable for FRL and product level
S	M, P, R, and C
R	M, P, and C
P	M and C
M	C

3.23.4 Substitutability of capacitance tolerance and rated voltage. Parts qualified and marked to tighter capacitance tolerance or higher rated voltage, with acquiring agency approval, are substitutable for parts marked to looser capacitance tolerance or lower rated voltage, provided all other values, such as case size, characteristic, and leads are the same. The substitutable parts shall not be remarked unless specified in the contract or acquisition document (see 6.2).

3.24 Workmanship. Capacitors shall be processed in such a manner as to be uniform in quality and shall be free from pits, corrosion, cracks, rough edges, and other defects that will affect life, serviceability, or appearance.

4. VERIFICATION

4.1 QPL system. The manufacturer shall establish and maintain a QPL system as described in 3.3. Evidence of such compliance is prerequisite for qualification and retention of qualification.

4.2 Classification of inspections. The inspections specified herein are classified as follows:

a. Qualification inspection (see 4.4).

b. Verification of qualification (see 4.5).

c. Conformance inspection (see 4.6).

d. Periodic group C inspection (see 4.6.2).

4.3 Inspection conditions and methods.

4.3.1 Conditions. Unless otherwise specified herein, all inspections shall be performed in accordance with the test conditions specified in the general requirements of MIL-STD-202.

4.3.2 Methods.

4.3.2.1 Reference measurements. When requirements are based on comparative measurements made before and after conditioning, the reference measurement shall be considered the last measurement made at 25°C ±5°C prior to conditioning. Unless reference measurements have been made within 30 days prior to the beginning of conditioning, they shall be repeated.

4.3.3 Power supply. The power supply used for life testing shall have a regulation of ±2 percent or less of the applicable applied test voltage. The power supply used for dc leakage current measurements shall be stabilized to at least ±100 ppm. No voltage fluctuations shall occur during measurements that would produce a variation in the current measurement.

* 4.4 Qualification inspection. Qualification inspection shall be performed at a laboratory acceptable to the Government (see 6.4), on sample units produced with equipment and procedures normally used in production. The decision to include or exclude the product from the QPL will be made after successful completion of the 2,000-hour life test.

4.4.1 Sample size. The number of sample units comprising a sample of capacitors to be submitted for qualification inspection shall be as specified in table VIII, or in appendix A of this specification. The sample shall be taken from a production run and shall be produced with equipment and procedures normally used in production. Each capacitor style shall be qualified separately.

4.4.2 Inspection routine. Sample units shall be subjected to the qualification inspection specified in table VIII, in the order shown. All sample units shall be subjected to group I and group II tests. These sample units shall then be divided as shown in table VIII for group III to group VI, inclusive, and subjected to the tests for their particular group. The units subjected to life test at rated conditions shall be continued on test for 48,000 additional hours.

4.4.3 Failures. Failures in excess of those allowed in table VIII shall be cause for refusal to grant qualification approval.

4.4.4 FRL and quality level verification.

4.4.4.1 Failure rate (FR) qualification and lot conformance FR inspection. FR qualification and lot conformance FR inspection shall be in accordance with the general and detailed requirements of MIL-STD-690 and the following details:

a. Procedure I: Qualification at the initial FRL. Level M (1.0 percent), of FRSP-90 shall apply. Upon successful completion of the 2,000-hour qualification test (group V, table VIII), those sample units which have been subjected to rated conditions shall be continued on test for an additional period as specified in 4.7.16.3.

b. Procedure II: Extension of qualification to lower FRL. To extend qualification to the P (0.1 percent), R (0.01 percent), and S (0.001 percent) FRLs, data from two or more voltages within a style and of similar construction may be combined. For FRLs R and S, two or more styles of similar construction (see 4.6.1.1.1) may be combined.

c. Procedure III: Maintenance of FRL qualification. Maintenance period B of FRSP-10 shall apply. Regardless of the number of production lots produced during this period, the specified number of unit hours shall be accumulated to maintain qualification (see 4.5f).

4.4.4.2 Quality level verification. The manufacturer is responsible for establishing a quality system to verify the ppm defect level of lots that are subjected to the group A inspections. The ppm defect level can be maintained for each specification sheet, or alternatively can combine all specification sheets. The ppm defect level shall be based on a 6-month moving average.

4.5 Verification of qualification. Every 6 months the manufacturer shall provide verification of qualification to the qualifying activity. Continued qualification is based on meeting the following requirements:

a. MIL-STD-790 program.

b. The capacitor design has not been modified.

c. Lot rejection for group A does not exceed 10 percent or one lot, whichever is greater.

d. Periodic group C inspection.

e. Verification of FRLs.

f. PPM assessment.

g. Continued qualification to non-ER (level C) shall be based upon maintenance of qualification for the ER part FRL P.

TABLE VIII. Qualification inspection.

Inspection	Requirement paragraph	Method paragraph	Number of sample units to be inspected	Number of defectives allowed 1/	
Group I 2/					
Dielectric withstanding voltage	3.6	4.7.2	102	0	
High voltage stabilization	3.7	4.7.3			
Group II 2/					
Visual and mechanical examination 3/	3.1, 3.4 to 3.5.2, 3.23 to 3.24.1	4.7.1			
Barometric pressure	3.8	4.7.4	4/ 102	0	
Insulation resistance	3.9	4.7.5			
Capacitance	3.10	4.7.6			
Dissipation factor	3.11	4.7.7			1
Group III					
Solderability	3.12	4.7.8			
Vibration	3.13	4.7.9	18	1	
Temperature coefficient and capacitance drift	3.14	4.7.10			
Thermal shock and immersion	3.15	4.7.11			
Group IV					
Shock, specified pulse	3.16	4.7.12			
Terminal strength	3.17	4.7.13	18	1	
Resistance to soldering heat	3.18	4.7.14			
Moisture resistance	3.19	4.7.15			
Group V					
Life (rated conditions)	3.20	4.7.16.1.1	50	1	
Life (accelerated conditions)	3.20	4.7.16.1.2	6		
Group VI					
Fungus 5/	3.21	4.7.17	5	0	
Resistance to solvents	3.22	4.7.18			

1/ A sample unit having one or more defects shall be considered a single defective.
2/ Nondestructive tests.
3/ Marking defects are based on visual examination only and shall be charged only for illegible, incomplete, or incorrect marking.
4/ Sample units shall be selected from those which have passed group I inspection.
5/ Certification of fungus resistance may be substituted for testing.

4.6 Conformance inspection.

4.6.1 Inspection of product for delivery. Inspection of product for delivery shall consist of group A inspection.

4.6.1.1 Inspection and production lot.

4.6.1.1.1 Inspection lot. An inspection lot shall consist of all capacitors from the same production line or lines, of the same style, rated voltage, dielectric material, and offered for inspection during a single work month. Each lot shall be kept separate from every other lot. The sample selected from the lot shall be representative of the capacitance values and case sizes in the lot. Styles CMR03, CMR04, CMR06, CMR07, and CMR08 may be combined for FRL maintenance.

4.6.1.1.2 Production lot. A production lot shall consist of all capacitors of the same style, voltage rating, characteristic, nominal capacitance value, capacitance tolerance, and case size. The manufacturer of all parts in the lot shall have been started, processed, assembled, and tested as a group. Lot identity shall be maintained throughout the manufacturing cycle.

4.6.1.2 Group A inspection.

4.6.1.2.1 Non-ER (level C). The manufacturer shall establish and maintain an inspection system to verify that capacitors meet the IR (25°C), capacitance, DF, solderability, and mechanical examination requirements. In-line or process control may be part of such a system. The inspection system shall also include criteria for lot rejection and corrective actions. The inspection system shall be verified under the overall MIL-STD-790 QPL system. NOTE: Since the non-ER (level C) is the ER design without the mandatory conformance system and FRL assessment, the product is still expected to meet the environmental qualification type requirements (e.g., shock, vibration, or moisture resistance).

4.6.1.2.2 ER capacitors.

4.6.1.2.2.1 Subgroup 1. Subgroup 1 tests shall be performed on a production lot basis on 100 percent of the product supplied under this specification. Capacitors failing the tests of subgroup 1 shall be removed from the lot. If, during the 100 percent inspection, screening requires that more than 8 percent of the capacitors be discarded, the entire production lot shall be rejected.

4.6.1.2.2.1.1 Manufacturer's production inspection. If the manufacturer performs tests equal to or more stringent than those specified in subgroup 1 as the final step of their manufacturing process, the subgroup 1 tests may be eliminated when approved by the qualifying activity. The following criteria must be compiled with:

a. The manufacturer production tests are identical to, or more stringent than, those specified for subgroup 1 tests.

b. One hundred percent of the product shall be subjected to these tests.

c. Failure criteria are identical to, or more stringent than, the subgroup 1 tests.

d. Lot rejection criteria are identical to, or more stringent than, the subgroup 1.

e. Once approved, future changes require approval from the qualifying activity.

4.6.1.2.2.2 Subgroup 2.

4.6.1.2.2.2.1 Sampling plan. Subgroup 2 tests shall be performed on an inspection lot basis. Samples subjected to subgroup 2 tests shall be selected in accordance with table IX, based on the size of the inspection lot. In the event of one or more failures, the lot shall be rejected.

4.6.1.2.2.2.2 Rejected lots. The rejected lot shall be segregated from new lots and those lots that have passed inspection. The rejected lots shall be 100 percent inspected for those quality characteristics found defective in the sample and any defective found removed from the lot. A new sample of parts shall then be randomly selected in accordance with table IX. If one or more defects are found in this second sample, the lot shall be rejected and shall not be supplied to this specification.

4.6.1.2.2.3 Subgroup 3.

4.6.1.2.2.3.1 Sampling plan. Subgroup 3 tests shall be performed on inspection lot basis. The number of samples selected shall be in accordance with table X. In the event of one or more failures, the lot shall be rejected.

4.6.1.2.2.3.2 Rejected lots. The rejected lot shall be segregated from new lots and those lots that have passed inspection. The rejected lots shall be 100 percent inspected for those quality characteristics found defective in the sample and any defective found, removed from the lot. A new sample of parts shall then be randomly selected in accordance with table X. If one or more defects are found in this second sample, the production lot shall be rejected and shall not be supplied to this specification.

* TABLE IX. Sampling plans.

Lot size	Sample size
1 - 12	100 percent
13 - 150	13
151 - 280	20
281 - 500	29
501 - 1,200	34
1,201 - 3,200	42
3,201 - 10,000	50
10,001 - 35,000	60
35,001 - 150,000	74
150,000 - 500,000	90

* TABLE X. Group A inspection (ER only).

Inspection	Requirement paragraph	Test method paragraph	Sample procedure
Subgroup 1			
High voltage stabilization	3.7	4.7.3	
Dielectric withstanding voltage	3.6	4.7.2	
Insulation resistance (at 25°C)	3.9	4.7.5	100% inspection
Capacitance	3.10	4.7.6	
Dissipation factor	3.11	4.7.7	
Subgroup 2 1/			
Visual and mechanical examination (including dimensions)	3.5, 3.23	4.7.1	See table IX
Subgroup 3			
Insulation resistance (at 125°C)	3.9.2	4.7.5.2	20 samples 0 failures
Subgroup 4			
Solderability 2/	3.12	4.7.8	5 samples 0 failures

1/ Marking defects are based on visual inspection only and shall be charged only for illegible, incomplete, or incorrect marking. Any subsequent electrical defects shall not be used as a basis for determining marking defects.

2/ The manufacturer may request the deletion of the subgroup 4 solderability test, provided an in-line or process control system for assessing and assuring the solderability of leads can be validated and approved by the qualifying activity. Deletion of the test does not relieve the manufacturer from meeting this test requirement in case of dispute. If the design, material, construction, or processing of the part is changed, or if there are any quality problems, the qualifying activity may require resumption of the test.

4.6.1.2.2.4 Subgroup 4 (solderability).

* 4.6.1.2.2.4.1 Sampling plan. Five samples shall be selected randomly from each inspection lot and subjected to the solderability test. The manufacturer may use electrical rejects from the subgroup 1 screening test for all or part of the samples to be used for solderability testing. If there are one or more defects, the lot shall be rejected.

4.6.1.2.2.4.2 Rejected lots. In the event of one or more defects, the inspection lot is rejected. The manufacturer may use one of the following options to rework the lot:

a. Each production lot that was used to form the failed inspection lot shall be individually submitted to the solderability test as required in 4.6.1.2.2.4.1. Production lots that pass the solderability test are available for

shipment. Production lots failing the solderability test can be reworked only if submitted to the solder dip procedure in 4.6.1.2.2.4.2b.

b. The manufacturer submits the failed lot to a 100 percent solder dip using an approved solder dip process in accordance with 3.4.2.1. Following the solder dip, the electrical measurements required in group A, subgroup 1 tests shall be repeated on 100 percent of the lot. The PDA for the electrical measurements shall be as for the subgroup 1 tests.

* Five additional samples shall be then selected and subjected to the solderability test with zero defects allowed. If the lot fails this solderability test, the lot shall be considered rejected and shall not be furnished against the requirements of this specification.

4.6.1.2.2.4.3 Disposition of samples. The solderability test is considered a destructive test and samples submitted to the solderability test shall not be supplied on the contract.

4.6.1.2.2.5 PPM calculations. The manufacturer shall establish a ppm system in accordance with 3.3.2 for assessing and calculating average outgoing quality of capacitors. A ppm rate combining DWV, IR (25°C), capacitance, and DF shall be assessed for lots that have passed the group A inspection. The manufacturer's ppm system shall also address rectification procedures for lots failing ppm assessment. Data from the rectification system shall not be used to calculate ppm.

4.6.2 Periodic inspection.

4.6.2.1 Group C inspection. Group C inspection shall be performed on sample units which have been subjected to and have passed group A inspection for FRL M, P, R, and S and shall consist of the tests specified in table XI in the order shown. The maximum and minimum case size manufactured during a month's production shall be represented in the sample in at least the approximate ratio of production. Test data obtained shall be reviewed as part of the complete verification of qualification.

4.6.2.1.1 Sampling plan.

4.6.2.1.1.1 For subgroup 1 and subgroup 2. Seventy-two sample units, representative of a month's production, shall be taken from production every 2 months, divided into subgroups as listed in table XI for subgroup 1 and subgroup 2, and subjected to the test specified herein. Allowable failures shall be as specified in table XI.

4.6.2.1.1.2 For subgroup 3. In addition to the tests specified in 4.6.2.1.1.1, a minimum of ten sample units from each inspection lot shall be subjected to subgroup 3 of table XI. Allowable failures shall be as specified in MIL-STD-690, table IV, maintenance period B.

4.6.2.1.2 Failures. If the number of failures exceeds the number allowed in table XI or MIL-STD-690, as applicable, the sample shall be considered to have failed.

4.6.2.1.3 Disposition of sample units. Sample units which have been subjected to group C inspection shall not be delivered on the contract.

4.6.2.1.4 Noncompliance. If a sample fails to pass group C inspection, the manufacturer shall take corrective action on the materials or processes, or both, as warranted, and on all units of product which can be corrected and which were manufactured under essentially the same conditions, with essentially the same materials and processes, and which are considered subject to the same failure. Acceptance of the product shall be discontinued until corrective action, acceptable to the Government, has been taken. After the corrective action has been taken, group C inspection shall be repeated on additional sample units (all inspections, or the inspection which the original sample failed, at the option of the Government). Group A inspections may be reinstitutued; however, final acceptance shall be withheld until the group C reinspection has shown that the corrective action was successful. In the event of failure after reinspection, information concerning the failure and corrective action taken shall be furnished to the cognizant inspection activity and the qualifying activity.

TABLE XI. Group C inspection.

Inspection	Requirement paragraph	Method paragraph	Number of sample units	Allowable failures
Subgroup 1				
Vibration 1/	3.13	4.7.9		
Temperature coefficient & capacitance drift	3.14	4.7.10	36	1
Thermal shock and immersion	3.15	4.7.11		
Subgroup 2				
Shock, specified pulse 1/	3.16	4.7.12		
Terminal strength 1/	3.17	4.7.13	36	1
Resistance to soldering heat 1/	3.18	4.7.14		
Moisture resistance	3.19	4.7.15		
Subgroup 3				
Life (2,000 hours accelerated)	3.20	4.7.16.2	10 2/	2/

1/ If the manufacturer can demonstrate that this test has been performed five consecutive times with zero failures, this test, with the approval of the qualifying activity, can be deleted. The manufacturer, however, shall perform this test every three years after the deletion as part of long term design verification. If the design, material, construction or processing of the part is changed, or if there are any quality problems, the qualifying activity may require resumption of the specified testing. Deletion of testing does not relieve the manufacturer from meeting the test requirements in case of dispute.

2/ See 4.6.2.1.1.2.

4.7 Methods of inspection.

4.7.1 Visual and mechanical examination. Capacitors shall be examined to verify that the materials, design, construction, physical dimensions, marking, and workmanship are in accordance with the applicable requirements (see 3.1, 3.4 to 3.5.2 inclusive, and 3.23 to 3.24.1, inclusive).

4.7.2 Dielectric withstanding voltage (see 3.6). Capacitors shall be tested in accordance with method 301 of MIL-STD-202. The following details shall apply:

a. Magnitude and nature of test voltage: 200 percent of rated dc voltage.

b. Duration of application of test voltage: Not less than 1 second nor more than 5 seconds. The duration of the test shall begin when 95 percent of the test potential is reached.

c. Points of application of test voltage: Between terminals.

d. Limiting value of surge current: Shall not exceed 50 milliamperes (mA) during charging and discharging.

e. Examination after test: Capacitors shall be examined for evidence of damage, arcing, and breakdown.

4.7.3 High voltage stabilization (see 3.7). Capacitors shall be subjected to 200 percent of rated dc voltage at a minimum temperature of 125°C or 150°C, as applicable, for a minimum of 48 hours. During the test, the capacitors shall be adequately protected against voltage surges of 25 percent or more of test voltage and surge current shall not exceed 50 mA. Capacitors shall be examined for evidence of damage, arcing, and breakdown. Insulation resistance shall then be measured as specified in 4.7.5.1.

4.7.4 Barometric pressure (see 3.8) (for qualification only). Capacitors shall be tested in accordance with method 105 of MIL-STD-202. The following details shall apply:

a. Method of mounting: Not applicable.

b. Test condition: D (100,000 feet).

c. Tests during subjection to reduced pressure: A test potential of 100 percent of rated dc voltage for style CMR04, 500 volts, and 150 percent for all other styles and voltages shall be applied between the terminals for 60 seconds +15 seconds, -0 second. Surge current shall not exceed 50 mA.

d. Examination after test: Capacitors shall be examined for evidence of damage, arcing, and breakdown.

4.7.5 IR (see 3.9).

4.7.5.1 At room ambient temperature (see 3.9.1). Capacitors shall be tested in accordance with method 302 of MIL-STD-202. The following details shall apply:

a. Test condition: A. (At the option of the manufacturer a higher voltage may be used.)

b. Points of measurement: From terminal to terminal. (Condensed moisture may be removed by a blast of air.)

4.7.5.2 At high ambient temperature (see 3.9.2). Capacitors shall be subjected to the high ambient temperature, 125°C +5°C, -0°C or 150°C, +5°C, -0°C, as applicable, for a period of time sufficient to reach thermal stability and shall be measured as specified in 4.7.5.1.

4.7.6 Capacitance (see 3.10). Capacitance shall be measured in accordance with method 305 of MIL-STD-202. The following details shall apply:

a. Test frequency: 1 megahertz (MHz) ±1,000 hertz (Hz) when the nominal capacitance is 1,000 pF or less, and 1 kilohertz (kHz) ±100 Hz when the nominal capacitance is greater than 1,000 pF. At the option of the manufacturer, capacitance measurements may be made at any frequency from 1 kHz to 1 MHz and referred to measurements at 1 MHz and 1 kHz, as applicable.

b. Limit of accuracy: Shall be ±0.2 percent of nominal capacitance value or ±0.2 pF, whichever is greater.

4.7.7 DF (see 3.11). Dissipation factor shall be measured at a frequency of 1 MHz ±1,000 Hz when the nominal capacitance is 1,000 pF or less, and 1kHz ±100 Hz when the nominal capacitance is greater than 1,000 pF. Measurement accuracy shall be within ±2 percent for DF and within ±5 Hz for frequency.

4.7.8 Solderability (see 3.12). Capacitors shall be tested in accordance with method 208 of MIL-STD-202. The following details may apply:

a. Number of terminations of each part to be tested: Two.

b. Depth of immersion in flux and solder: To a point at which exposed metal is solderable.

c. No physical damage after test.

4.7.9 Vibration (see 3.13).

4.7.9.1 Vibration, high frequency. Capacitors shall be tested in accordance with method 204 of MIL-STD-202. The following details and exceptions shall apply:

a. Mounting: Capacitors shall be rigidly mounted by the body to vibration-test apparatus.

b. Test condition: B.

c. Measurements during vibration: During the last cycle in each direction, an electrical measurement shall be made to determine intermittent contacts of 0.5 ms or greater duration or open-circuiting or short-circuiting.

d. Examination and measurements after test: Capacitors shall be examined for evidence of mechanical damage.

4.7.9.2 Vibration, random. Capacitors shall be tested in accordance with method 214 of MIL-STD-202. The following details shall apply:

a. Mounting: Body of the capacitors shall be rigidly supported.

b. Test condition: E of table 214-II of MIL-STD-202.

c. Duration and direction of motion: 1 hour 30 minutes in each of three mutually perpendicular directions (total of 4 hours 30 minutes).

d. Measurements: During the last 30 minutes in each direction, an electrical measurement shall be made to determine intermittent contacts, or open-circuiting or short-circuiting. Detecting equipment shall be sufficiently sensitive to detect any interruption of 0.5 ms or greater duration.

e. Examination after test: Capacitors shall be examined for evidence of mechanical damage.

4.7.10 Temperature coefficient and capacitance drift (see 3.14).

4.7.10.1 For qualification inspection. Capacitance measurements shall be made in accordance with 4.7.6 (a frequency of 100 kHz ± 10 percent may be used as an alternate) at the following temperatures in the order listed:

Step	Temperature °C	Step	Temperature °C
1	25 ±2	6	45 ±2
2	-55 +0, -2	7	65 ±2
3	-40 ±2	8	+85 +2, -0
4	-10 ±2	9	125 +2, -0 (For temperature ranges O and P)
5	25 ±2	10	150 +2, -0 (For temperature range P)
		11	25 ±2

The measurement at each temperature shall be recorded when two successive readings taken at 5-minute intervals at that temperature indicate no change in capacitance. An accuracy of ±0.025 percent of nominal capacitance +0.05 pF shall be maintained for measurement of capacitance change.

4.7.10.1.1 Temperature coefficient. The temperature coefficient shall be computed as follows:

$$TC = \frac{(C_x - C_5)10^6}{(T_2 - T_1)C_5}$$

Where:
- TC = Temperature coefficient in ppm degree centigrade.
- C_x = Capacitance at test temperature in pF.
- C_5 = Capacitance at step 5 temperature in pF.
- T_1 = 25°C
- T_2 = Test temperature in degrees centigrade.

4.7.10.1.2 Capacitance drift. Capacitance drift shall be computed by dividing the greatest single difference between any two of the three values recorded at 25°C by the step 5 value recorded at 25°C.

4.7.10.2 For quality conformance inspection. Capacitance measurements shall be made as specified in 4.7.10.1, except that measurements shall be made only for step 1, step 2, step 5, step 9, or step 10, as applicable, and step 11.

4.7.10.3 Continuous-curve temperature coefficient. As an alternate to the measurements specified in 4.7.10.1, a continuous curve of capacitance versus temperature may be produced by subjecting the capacitors to a slowly varying temperature. The temperature shall be varied from 25°C to +55°C, to 125°C or 150°C, as applicable, and to 25°C. A temperature-sensing device shall be embedded in a dummy capacitor in a manner to assure accurate internal readings in the capacitor under test. The temperature shall be varied slowly enough to produce a smooth, uniform curve with no loops at -55°C or 125°C or 150°C, as applicable. Measurements shall be made at a frequency of 100 kHz ±10 kHz. Accuracy shall be as specified in 4.7.10.1.

4.7.11 Thermal shock and immersion (see 3.15).

4.7.11.1 Thermal shock. Capacitors shall be tested in accordance with method 107 of MIL-STD-202. The following details and exceptions shall apply:

a. Test condition: A, except that elevated temperature shall be 125°C +3°C, -0°C, or 150°C, +3°C, -0°C, as applicable.

b. Measurement before cycling: Capacitance.

c. Measurement after cycling: Not applicable.

4.7.11.2 Immersion. The temperature cycling shall be followed by immersion cycling in accordance with method 104 of MIL-STD-202, test condition B. Capacitors shall be visually examined for evidence of deterioration, permanent damage to leads and case, and corrosion on the leads. Dielectric withstanding voltage, IR, capacitance, and DF shall then be measured as specified in 4.7.2, 4.7.5.1, 4.7.6, and 4.7.7 respectively.

4.7.12 Shock, specified pulse (see 3.16). Capacitors shall be tested in accordance with method 213 of MIL-STD-202. The following details shall apply:

a. Mounting: Capacitors shall be rigidly mounted by the body.

b. Test condition: I (100 G (pk), sawtooth).

c. Measurements during shock: During the last shock in each direction, an electrical measurement shall be made to determine intermittent contacts of 0.5 ms or greater duration or open-circuiting or short-circuiting.

d. Measurements after shock. Capacitors shall be examined for evidence of mechanical damage.

4.7.13 Terminal strength (see 3.17).

4.7.13.1 Pull test. All terminals shall be subject for 5 seconds ±1 second, to a pull of 5-pounds +2 ounces, -0 ounces in a direction perpendicular to the leads.

4.7.13.2 Twist test. Capacitors shall be tested in accordance with method 211 of MIL-STD-202, test condition D.

4.7.14 Resistance to soldering heat (see 3.18). Capacitors shall be tested in accordance with method 210 of MIL-STD-202. The following details and exceptions shall apply:

a. Depth of immersion: Within .250 inch (6.35 mm) of the case.

b. Test condition: C.

c. Cooling time prior to final measurement: 1 minute ±10 seconds.

d. Measurements after test: Insulation resistance, capacitance, and DF shall be measured as specified in 4.7.5, 4.7.6, and 4.7.7, respectively.

4.7.15 Moisture resistance (see 3.19). Capacitors shall be tested in accordance with method 106 of MIL-STD-202. The following details and exceptions shall apply.

a. Number of cycles: Capacitors shall be subjected to twenty continuous temperature cycles.

b. Mounting: Capacitors shall be mounted by the leads in a manner that will keep the capacitor body from touching the test fixture during test or measurement.

c. Conditioning prior to test: Capacitors shall be tested as specified in 4.7.11.1.

d. Polarization: A dc potential of 100 volts or rated volts, whichever is less, shall be applied across the capacitor terminals of 50 percent of the units under test and no voltage applied to the other 50 percent.

e. Vibration: The vibration requirement of steps 7a and 7b shall not apply.

f. Final measurements: After completion of step 6 of the final cycle, capacitors shall be maintained at 25°C ±5°C, and 50 ±5 percent relative humidity for a period of 4 to 24 hours. Insulation resistance, DWV, capacitance, and DF shall then be measured as specified in 4.7.5.1, 4.7.2, 4.7.6, and 4.7.7, respectively. Capacitors shall then be examined for evidence of deterioration, permanent damage to the leads or case, and corrosion on the leads.

4.7.16 Life (see 3.20). Capacitors shall be preconditioned for life test by subjecting them to a temperature of -55°C +0°C, -2°C for a minimum period of 48 hours. Capacitors shall then be subjected to the tests specified in 4.7.16.1 or 4.7.16.2 as applicable.

4.7.16.1 For qualification inspection (2,000 hours) (see 3.20).

4.7.16.1.1 Rated conditions. Capacitors shall be subjected to 100 percent of rated dc voltage at 125°C ±3°C or 150°C ±3°C, as applicable, for 2,000 hours +72 hours, -0 hour. During the test, the surge current shall be limited to 50 mA. At the conclusion of the test, capacitors shall be returned to the inspection conditions specified in 4.3.1, and shall be visually examined for evidence of mechanical damage; the DWV, insulation resistance, capacitance, and DF shall then be measured as specified in 4.7.2, 4.7.5, 4.7.6, and 4.7.7, respectively (see 3.20).

4.7.16.1.2 Accelerated conditions. Capacitors shall be tested as specified in 4.7.16 and 4.7.16.1.1, except that the capacitors shall be subjected to 150 percent of rated dc voltage.

4.7.16.2 For quality conformance inspection (see 3.20).

4.7.16.2.1 For FRL M, P, R, and S. Capacitors shall be tested as specified in 4.7.16.1.2.

4.7.16.3 Extended life (see 3.20).

4.7.16.3.1 Following 2,000 hour qualification test. Capacitors shall be continued on test for an additional 8,000 hours +96 hours, -0 hour; measurements during and after exposure shall be accomplished after 2,000 hours +96 hours, -0 hour and every 2,000 hours +96 hours, -0 hour thereafter until a combined total of 10,000 hours +96 hours, -0 hour have elapsed. The measurements are the same as those specified in 4.7.16.1.1.

4.7.17 Fungus (see 3.21). Capacitors shall be tested in accordance with method 508 of MIL-STD-810. Pretest and post-test measurements are not required.

4.7.18 Resistance to solvents (see 3.22). Capacitors shall be tested in accordance with method 215 of MIL-STD-202. The following details shall apply:

a. Portion of specimen to be brushed: That portion on which marking is present.

b. Number of specimens to be tested: As specified in table VIII.

c. Permissible extent of damage: As specified in 3.22.

5. PACKAGING

* 5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When packaging of materiel is to be performed by DoD or in-house contractor personnel, these personnel need to contact the responsible packaging activity to ascertain packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activities within the Military Service or Defense Agency, or within the military service's system commands. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

* 6.1 Intended use. The capacitors covered by this specification are intended for use in equipment where a known order of reliability is required. These capacitors offer optimum high temperature characteristics and excellent capacitance stability.

6.2 Acquisition requirements. Acquisition documents must specify the following:

a. Title, number, and date of this specification, date of the applicable specification sheet, and the complete type designation (see 1.2.1 and 3.1).

b. Issue of DoDISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.1).

c. Packaging requirements (see 5.1).

d. Marking requirements for FRL (see 3.23).

6.3 Retinning leads. If retinning (hot solder dip) of the leads is required, see 3.4.2.1.

* 6.4 Qualification. With respect to products requiring qualification, awards will be made only for products that are, at the time of award of contract, qualified for inclusion in QPL whether or not such products have actually been so listed by that date. The attention of the contractors is called to these requirements, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or orders for the products covered by this specification. The activity responsible for the QPL is the U.S. Army Communications-Electronics Command, ATTN: AMSEL-LC-LEO-E-EP, Fort Monmouth, NJ 07703-5023; however, information pertaining to qualification of products may be obtained from the Defense Supply Center, Columbus, ATTN: DSCC-VQP, PO Box 3990, Columbus, OH 43216-5000, or by e-mail to vqp.chief@dla.mil.

6.4.1 Copies of forms. Copies of "Provisions Governing Qualification" may be obtained upon application to Defense Printing Service Detachment Office, Building 4D (Customer Service), 700 Robbins Avenue, Philadelphia, PA 19111-5094.

6.4.2 FRL qualification. Where the invitation for bids specifies a FRL below the P level, awards will be made only for those products that have been qualified prior to the bid-opening date by the qualifying activity as meeting the FRL specified in the invitation for bids.

* 6.5 Selection and use information. Equipment designers should refer to MIL-HDBK-198, "Capacitors, Selection and Use of" for a selection of standard capacitor types and values for new equipment design. Application and use information concerning these capacitors are also provided in MIL-HDBK-198.

6.6 FRL determination. The curves presented on figure 3 and figure 4 are the best engineering approximation of the reliability characteristics (random failures) for these capacitors when employed repeatedly, within their specification ratings, in complex electronic equipment. These reliability characteristics are based on ground-level severity experience. Failures are considered to be opens, shorts, or radical departures from initial characteristics. The failures are considered to be occurring in an unpredictable manner and in too short a period of time to permit detection through normal preventive maintenance. The curves shown on this figure are based on catastrophic failures and will differ from the FR established in the specification, since the established FR are based on parameter failures over long term life tests at rated conditions. Figure 3 and figure 4 have been extracted from MIL-HDBK-217, "Reliability Stress and Failure Rate Data for Electronic Equipment." The curves have been modified from their original versions in that the ordinate has been normalized in order to provide multiplier factors in place of discrete FRLs and in order that the multiplying factor for a FR at rated conditions is unity. As indicated, these curves are the best estimates based on catastrophic failures; however, they can provide an estimate of the relative effect of operating under conditions other than rated.

6.7 Subject term (key word) listing.

Capacitance

6.8 Tin plated finishes. Tin plating is prohibited (see 3.5.1) because it may result in tin whisker growth. Tin whisker growth could adversely affect the operation of electronic equipment systems. For additional information, see ASTM 8545, "Standard Specification for Electrodeposited Coating of Tin."

* 6.9 Environmentally preferable material. Environmentally preferable materials should be used to the maximum extent possible to meet the requirements of this specification. Table XII lists the Environmental Protection Agency (EPA) top seventeen hazardous materials targeted for major usage reduction. Use of these materials should be minimized or eliminated unless needed to meet the requirements specified herein (see section 3).

* TABLE XII. EPA top seventeen hazardous materials.

Benzene	Dichloromethane	Tetrachloroethylene
Cadmium and Compounds	Lead and Compounds	Toluene
Carbon Tetrachloride	Mercury and Compounds	1,1,1 - Trichloroethane
Chloroform	Methyl Ethyl Ketone	Trichloroethylene
Chromium and Compounds	Methyl Isobutyl Ketone	Xylene
Cyanide and Compounds	Nickel and Compounds	

* 6.10 Changes from previous issue. The margins of this specification are marked with asterisks to indicate where changes from the previous issue were made. This was done as a convenience only and the Government assumes no liability whatsoever for any inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content irrespective of the marginal notations and relationship to the last previous issue.

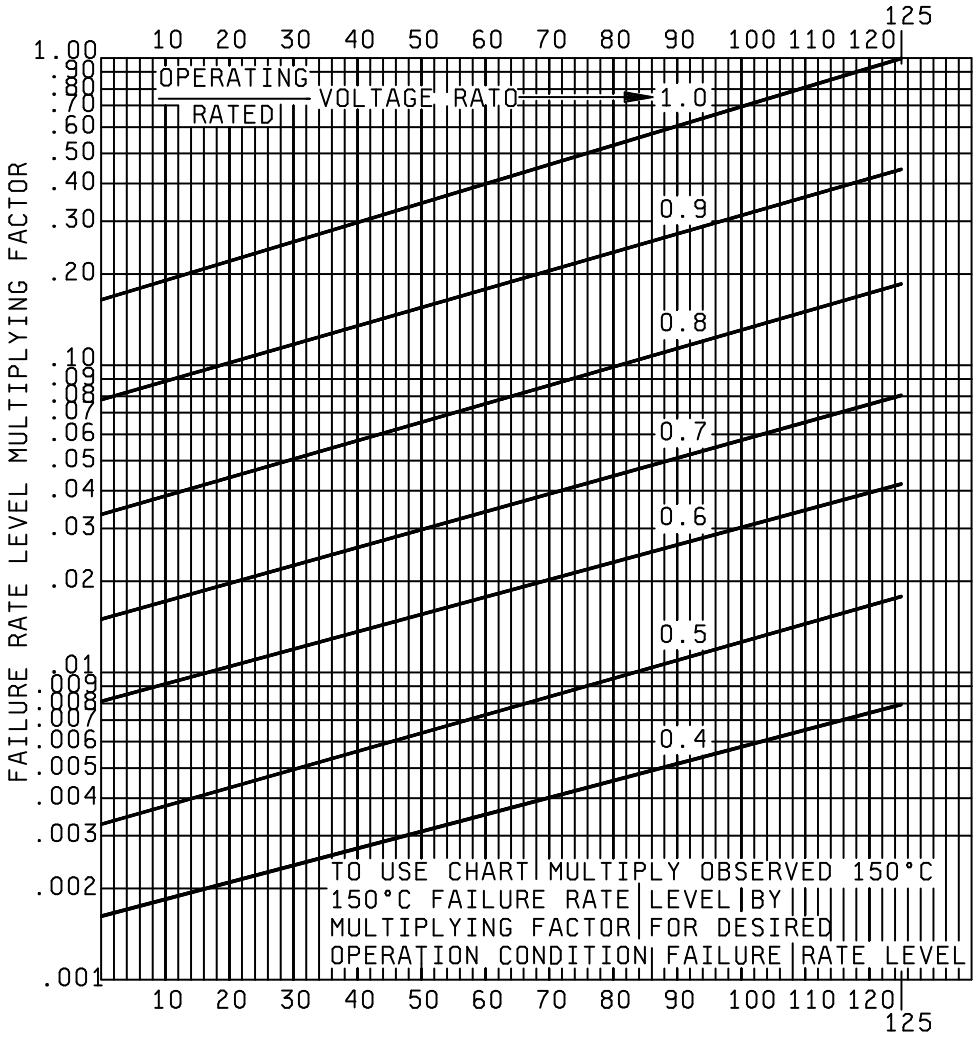

FIGURE 3. FR curves; 0°C to 125°C.

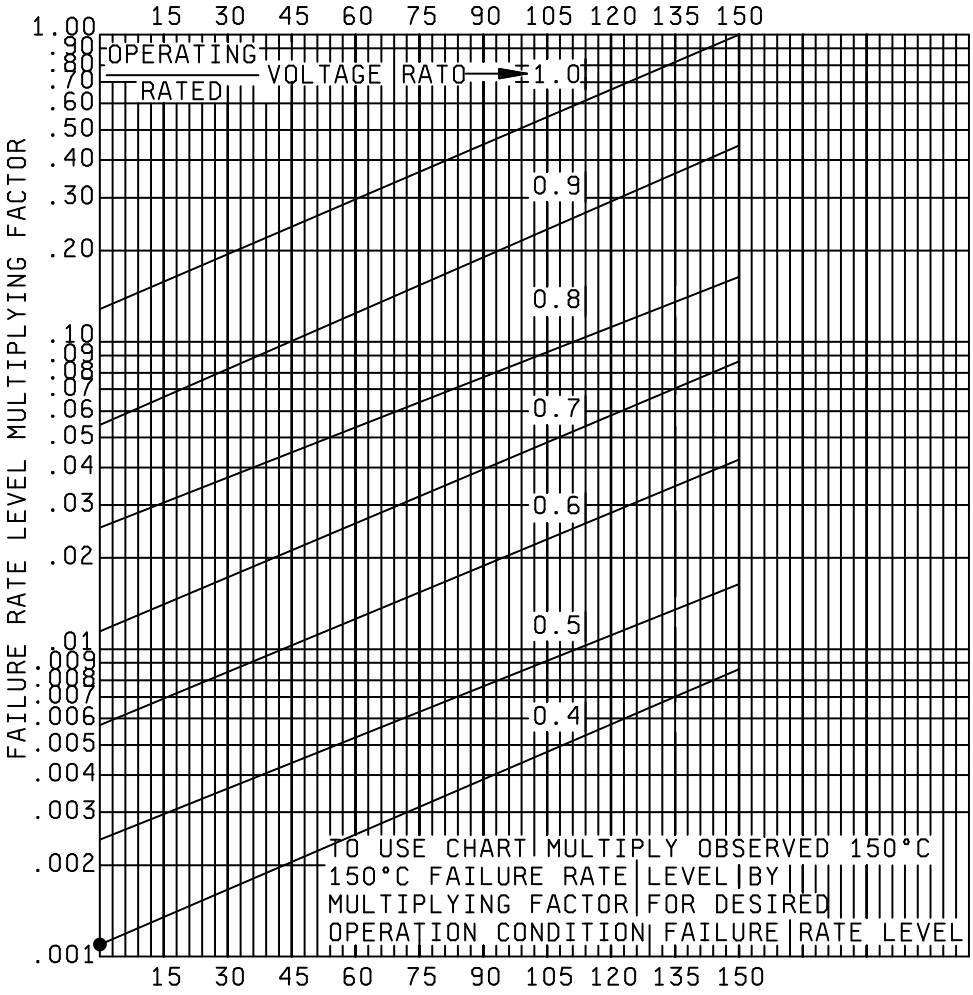

FIGURE 4. FR curves; 0°C to 150°C.

APPENDIX A

PROCEDURE FOR QUALIFICATION INSPECTION

A.1. SCOPE

A.1.1 Scope. This appendix details the procedure for submission of samples for initial qualification inspection of capacitors covered by this specification. The procedure for extending qualification of the required sample to other capacitors covered by this specification is also outlined herein. This appendix is a mandatory part of the specification. The information contained herein is intended for compliance.

A.2. APPLICABLE DOCUMENTS (This section is not applicable to this appendix.)

A.3. SUBMISSION

A.3.1 Sample.

A.3.1.1 Single-type submission. A sample consisting of 102 sample units of each type for which qualification is sought shall be submitted (see A.4.1).

A.3.1.2 Single-style submission. A maximum of two types, 51 of each type, may be represented in a single style submission. Both types shall be of the same capacitance tolerance and characteristics. The highest and lowest capacitance value within a style or characteristic shall be equally represented. However, where the lowest capacitance value listed for a particular style or characteristic is below 47 pF, specimens of the 47 pF value, or preferably lower, may be submitted.

A.4. EXTENT OF QUALIFICATION

A.4.1 Single-type designation. Qualification will be restricted to the style, capacitance value, characteristic, and capacitance tolerance equal to or broader than the characteristic and capacitance tolerance submitted.

A.4.2 Single-style submission. Qualification of all types in the submission automatically carries with it qualification of all types within the style and capacitance range submitted, except that approval of the lowest capacitance value in the F characteristic will be the basis for approval of all lesser capacitance values and broader characteristics within a style. Qualification of characteristics and capacitance tolerances shall be restricted to those equal to or broader than that submitted. This extension of qualification is contingent on the use of the same materials, design, and construction for all types qualified. Wherever material, design, or constructional differences exist, submission shall be made in accordance with A.3.1.1.

Custodians:
Army - CR
Navy - EC
Air Force - 11
DLA - CC

Review activities:
* Air Force - 19

Preparing activity:
Army - CR

Agent:
DLA - CC

(Project 5910-2240)

* NOTE: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, you should verify the currency of the information above using ASSIST Online database at www.dodssp.daps.mil.